Missouri
Department
of Transportation

MoDOT

Pete K. Rahn, Director

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October 20, 2009

Dear Consultant:

The Missouri Highways and Transportation Commission is requesting the services of a photogrammetric consulting firm to perform the described professional services for the projects included on the attached exhibit. One or more consultants may be selected to perform a portion or all of these services.

If your firm would like to be considered for these consulting services, you may express your interest by responding to the appropriate office, which is indicated on the attachments. Limit your letter of interest to no more than two pages. This letter should include a statement to indicate why your firm is interested in the project. It should also include any other information, which might help us in the selection process, such as the persons or team you would assign to each project, the backgrounds of those individuals, and other projects your company has recently completed or are now active. We will utilize the consultant information already on file so we will not need a lengthy submittal of other general company information. If you have any questions pertaining to the consultant information on file, please contact Sandra Riley at 573-522-2002.

DBE firms must be certified by the Missouri Department of Transportation in order to be counted as participation towards an established DBE Goal. We encourage DBE firms to submit letters of interest as prime consultants for any projects they feel can be managed by their firm.

All letters must be received by 4:00 p.m., November 3, 2009 to the address listed below.

Missouri Department of Transportation
P.O. Box 270
601 W. Main
Jefferson City, MO 65102
Attention: Bradley McCloud – Photogrammetry

You may also submit letters of interest by fax to (573) 526-4535 or E-mail at Bradley.McCloud@modot.mo.gov. A fax or E-mail will be sent to notify the sender that the letter of interest was received. If you have any questions feel free to contact Bradley McCloud at (573) 526-2955.

Sincerely,

Dave Nichols
Director of Project Development

bm/jr

Attachments

cc: Kathy Harvey – de

EXHIBIT I

SCOPE OF SERVICES

The work covered by this Agreement shall include furnishing equipment, materials, professional, technical, and personnel resources necessary for the performance of aerial photography and control surveying services for design and development of the specified highway project.

The following information will explain and define the items of importance relating to this project. All the elements of work, that are necessary to satisfactorily complete the aerial photography of this project; may not be listed. The lack of a specific listing of an element or item of work does not, in itself constitute a basis for additional services or work supplement, and/or adjustment in compensation.

I. PROJECT

Aerial photography and control surveying for the specified project areas shall include ground targeting, aerial photography, and control surveying. The services shall provide data necessary for application in preliminary highway design.

II. PROJECT LOCATION AND LIMITS

The project sites are located in Missouri. The limits of each site are located in files furnished by MoDOT. Refer to the tables provided below for specific descriptions of each project.

TABLE II-1
AERIAL PHOTOGRAPHY PROJECT LOCATIONS

Job Number	County	RTE	Mile +/-	Photo Scale	Description of Project / Special Conditions
J1P0565	Buchanan	59	1.4	1:5080	Approx. 3000 ft. south of bridge to 4500 ft. north of the bridge
J3P2194	Warren	47	15.2	1:5080	Minor road WOW project, hopefully to add shoulders. Entire project goes from 0.1 miles south of Rte M/MM (in Warrenton) to Washington. Only need flown/mapped from south of Rte M/MM to approximately Rte D at Marthasville.
J3P0533	Audrain/Ralls/Pike	54	60	1:5080	Corridor Improvements from Mexico to Louisiana. VE study recommended "shared 4-lane" following existing route.
J4I2291	Cass	71	5.5	1:5080	Add median lanes from 155th St to North Cass Parkway. Mapping for 155th St interchange already completed.

J4P2292	Jackson	50	2	1:5080	Interchange improvements at MO 291 South Junction - Map 2.0 miles along Rte 50, including outer roads; 1000 ft. north & 3000 ft. south along Rte 291
J4I2293	Jackson	70	8.5	1:5080	Add median lanes from Rte 7 in Blue Springs to Rte F in Oak Grove
J4P1139/ J4P1117	Johnson/ Henry	13	23.5	1:5080	Add Lanes from Johnson Co. RT Y to Henry Co. Rte 7
J4U1166	Clay	169	1.2	1:5080	Interchange at 96th Street - Map 6000 ft. along 169, 2500 ft. east, 2500 ft. west along 96th St.
J4U1165	Clay	169	1.2	1:5080	Interchange at 108th Street - Map 6000 ft. along 169, 2000 ft. east, 2000 ft. west along 108th St.
J4U1165/ J4U1166	Clay	169	5.0	1:12000	Along Rte. 169 from 2000 ft. north of Interchange at 108th St. to 2000 ft. south of Interchange at 96th St.
J4I2295	Clay	I-435	.25	1:5080	I-435 / Rte. 210 Interchange improvements.
J4I2294	Clay	I-29	3.7	1:12000	Study for capacity improvements at Rte 169 Interchange
J4I1068	Clay/ Jackson	I-435	4.5	1:12000	Study for capacity improvements from N. 48th St. to Front Street
J5S0636	Boone	740	5	1:5080	740 Extension to I-70
J5P2188	Camden	5	1.7	1:5080	Hurricane Deck Bridge Replacement
J5P0820B	Cole	50	1	1:5080	Whitton Expwy. Widening & Interchg.
J5P0950	Osage/Maries	63	27.5	1:5080	4 lane relocation from Rte. 50 to Gasconade River
J6I2073	Franklin	I-44	2.3	1:5080	Scoping to realign Rte. 50 & I-44
J8P0601	Green	160	5.1	1:5080	160 from I-44 to Willard

TABLE II-2
TARGETING/SURVEY CONTROL PROJECT LOCATIONS

Project #	County	RTE	Mile +/-	Photo Scale	Description of Project / Special Conditions
J3P2194	Warren	47	15.2	1:5080	Minor road WOW project, hopefully to add shoulders. Entire project goes from 0.1 miles south of Rte M/MM (in Warrenton) to Washington. Only need flown/mapped from south of Rte M/MM to approximately Rte D at Marthasville.
J3P0533	Audrain/Ralls/Pike	54	60	1:5080	Corridor Improvements from Mexico to Louisiana. VE study recommended "shared 4-lane" following existing route.
J6I2073	Franklin	I-44	2.3	1:5080	Scoping to realign Rte. 50 & I-44
J8P0601	Green	160	5.1	1:5080	160 from I-44 to Willard

III. SERVICES AND DATA PROVIDED BY THE COMMISSION

The Commission will provide available information of record to the Consultant as well as:

1) The project locations and limits (.dgn format).

2) Preliminary flight plans (ASCII and .dgn format).

3) Mapping & photography limits (.dgn format).

4) The MoDOT *Specifications for Vertical Aerial Photography.*

5) Mission and County numbers will be provided for labeling of digital photography.

6) MoDOT's GPS Reference Station Network will be used in the control survey.

IV. SCOPE OF WORK

Work covered in this document shall include furnishing the professional, technical, and other personnel necessary for targeting, aerial photography and control surveying for the project. The services shall address the following:

1) **Planning**. The Consultant is responsible for project planning as it relates to coordinating the photo control targeting prior to the photo mission. Upon completion of the flying mission and photography processing, the Consultant shall provide the Commission with digital aerial images and contact prints with the north arrow and the photo control on the front of the photo and a description of the point (s) on the back of the photo.

2) **Mission Planning**. The Consultant shall be responsible for the final flight plan. Consultant shall verify the preliminary flight plan provided by the Commission, and shall make the necessary adjustments to meet ALL required specifications herein.

   MoDOT Photogrammetry will perform the preliminary flight planning, and preliminary flight lines will be provided to the Consultant. The preliminary flight plan designates the desired photography coverage area by the district.

MoDOT Photogrammetry uses Intergraph ISMP to perform mission planning. The electronic files from ISMP or ASCII export files are available to the Consultant.

3) **Project Limits**. Targeting and control surveying will be performed within the limits that are graphically marked and indicated on the Commission provided map files.

4) **Target planning**. All projects requiring mapping are targeted. Projects are to be targeted so that the use of vertical only points and photo identifiable points are not required. Control of the largest practical area will be done to allow for the possibility of mapping extra area if needed. Target placement at a minimum, must satisfy the control requirements of the mapping area.

   Flight lines and targets shall be adjusted as needed by the Consultant to provide the necessary control for the project. Additional exposures can be added at the discretion of the Consultant if needed to establish target locations at the ends of flight lines.

   Notification of target placement: The Survey Consultant shall notify the Aerial Photography Consultant upon placement of targets for each job. This notification may be by phone if followed up by e-mail.

   See Table II-2 for projects that will need targeting and survey control.

5) **Standards**. The Consultant shall comply with the most recent and applicable State and Federal Laws. Aerial photographic procedures shall be preformed in a manner that supports photogrammetric compilation in accordance with the United States National Map Accuracy Standards and any applicable portion of the Missouri Department of Transportation Engineering Policy Guide, Section 238.1; Photogrammetric Surveys.

V. SPECIFICATIONS FOR SURVEYING

1) **Notification of Target Placement**. The survey Consultant shall notify the photogrammetric Consultant upon placement of targets for each job. This notification may be by phone if followed up by e-mail.

2) **Material for Targets**. White paint or reflective white marking tape is used for targets on paved surfaces. Unbleached muslin or white plastic is used for grass, dirt and aggregate surfaces.

3) **Location of Targets**. The mapping project must begin and end with three control targets, which are placed roughly in a triangular pattern. The two lateral targets should be spaced at the offset distance and the third target should be near the mapping corridor. No mapping will be done beyond the last target so enough targets should be placed to ensure adequate coverage. Position targets in locations with a good field of view to minimize the cutting of vegetation and reduce the number of required ground setups. Targets are located as required for visibility from the air in areas free of shadows.

   When targets are placed upon paved shoulders of the roadway, it is suggested that the northern shoulder be used to avoid obscuring the target with shadows from objects on the southern side of the road. When cloth targets are placed, they should be located on level areas, with all underbrush and weeds adjacent to the targets removed.

   Targets shall be located where they are least likely to be disturbed. Targets are placed so that the time lapse between placing the targets and the photography is held to a minimum. If the time lapse is of such duration as to cause doubt of the target condition, the targets are to be checked immediately prior to photography.

   GPS locations shall be collected for each target placed (5/8 X 12-15 inch iron pin with center punch or chiseled X-cut set below the ground surface). This will allow the pin to be re-located if the target is removed. Guard lath shall be driven next to targets where possible. The name and phone number of the survey Consultant shall be on the lath.

   Consultant shall notify each property owner prior to placement of targets. Consultant shall notify MoDOT immediately of any problems encountered with property owners.

4) **Size and Shape of Targets**. Acceptable sizes and shapes of targets for the various flights heights are illustrated on Figure 238.1 1 of the departments Engineering Policy Guide.
   http://epg.modot.org/index.php?title=Main_Page

5) **Control Survey**. The Consultant shall perform a control survey for the project. This survey will ensure precise positions of traverse stations and/or GPS network stations throughout the project.

The survey shall comply with the following specifications. If any portion of the survey does not comply with these specifications, a written report substantiating the material variances for the specification with the responsible surveyor's signature is required. The Commission reserves the right to disallow variation.

a. Horizontal Control. The control point pairs will be tied to the MoDOT GPS Reference Station Network where available. Double occupancy RTK surveys within the MoDOT GPS Reference Station Network with a fixed ambiguity within said network and a minimum of 4 hours between occupations of control points. If the MoDOT network is unavailable then the control points will be tied the National Spatial Reference System (NSRS) through direct GPS ties to first or second order stations as defined in 20 CSR 2030-18.010 NSRS horizontal and vertical monuments using post-processing software or by NGS OPUS solutions. All OPUS solutions shall be based on a minimum of two hours of dual frequency data. On projects with more than one intervisible pair, the adjacent pairs will be tied together. On projects of two or three pairs the beginning and end points shall be joined by a GPS vector. On projects having four or more pairs, the beginning and ending pairs so connected will have ties into the NSRS. The control station is to be described in such a manner as to facilitate navigation and recovery of its location. Only static or rapid-static GPS procedures are permitted for this survey type.

b. Vertical Control. The control points will be referenced to NGS Vertical control. Benchmarks near the project should be used for the vertical reference for a project. If the NGS vertical control marks are not found nearby or a considerable distance away, then the GPS derived, elevations should be used for the project.

c. Benchmarks. Benchmarks should be placed approximately 1200 to 1800 feet apart throughout a project. Benchmarks should be without movement and set on objects and in locations that will remain undisturbed. Some examples listed in order of preference are bridge abutments and culvert headwalls that

aren't involved in a project, anything on a concrete structure that can be located (square in sidewalk near building, etc.), fire hydrants, railroad spikes in power polls, and railroad spikes in trees. A tie to these benchmarks is required in the form of a navigation description to the benchmark and three-point reference ties.

6) **Linear measures**. Linear measures will be made in the English System. The base unit will be the United States Survey Foot (and decimal parts thereof).

7) **Coordinate System**. All coordinates shall be based on the State Plane Coordinate System, North American Datum (NAD) of 1983 (1997) in the appropriate zone.

8) **Vertical Datum**. The elevations shall be based on the North American Vertical Datum (NAVD) of 1988.

9) **Global Positioning System (GPS)**. Consultant will use Global Positioning System (GPS) survey technology to establish the ground control. The elevations shall be based upon ellipsoidal heights that have been modified by the NGS Geoid 03 model.

10) **Projection Factor**. The Consultant is responsible for developing a project projection factor based on the Missouri Coordinate System of 1983 Manual for Land Surveyors.

a. Scale Factor. Using the most easterly and westerly control points within the project to develop a centroid point for a project. Use the converted English easting of the centroid point in the correct zone formula below.

East Zone =
(easting – 820,208.3333) *0.00000000045 * (easting – 820,208.3333) + 0.9999333 = 393,700

Central Zone =
(easting – 1,640,416.6665) *0.00000000045 * (easting – 1,640,416.6665) + 0.9999333 = 393,700

West Zone =
(easting – 2,788,708.3331) *0.00000000045 * (easting – 2,788,708.3331) + 0.9999412 = 393,700

b. Elevation Factor is determined by dividing the ellipsoid radius by the ellipsoid radius plus the mean elevation for the project.

$$\text{Elevation Factor} = \frac{20909689}{[20909689 + (\text{elevation in feet} - 100.065)]}.$$

c. Grid Factor is the result of multiplying the Elevation Factor by the Scale Factor of the centroid point of the project.

Grid Factor = Elevation factor X Scale factor

d. Projection Factor is the reciprocal of the grid factor.

Projection Factor = 1 / Grid factor

11) **Types of Control Points:**

a. Primary Control. A Primary Control Survey Network (PCSN) consisting of semi-permanent, intervisible, control point pair(s) (5/8 x 12-15 inch iron pin with center punch or chiseled X-cut set below the ground surface) will be set and referenced at each site. One intervisible control point pair will be established for approximately each mile of alignment. A constrained least squares adjustment shall be made for all the points that comprise the PCSN. If a single project exceeds twenty (20) miles in length, a supplemental control tie to the NSRS shall be made at the approximate midpoint.

The survey report shall include a summary of closures and accuracies for the PCSN. A minimum of three (3) reference ties to recoverable accessories will be made for each control station. The control station is to be described in such manner as to facilitate navigation and recovery of its location. Only static or rapid-static GPS procedures are permitted for this survey type. Double occupancy RTK surveys within the MoDOT GPS Reference Station Network with a fixed ambiguity within said network and minimum of 4 hours between occupations of control points will be allowed.

b. Photo Control Points (target/photo-identifiables). The Consultant will plan and establish horizontal and vertical photo control points required for the topographic mapping. Pins will be recessed for targets that are not located on a paved surface. The elevation of both the target and the pin will be reported. With the ground elevation going to the .CTL file and the pin

elevation going to the .REC file. The accuracies shall be sufficient to support the topographic mapping requirements. Photo-identifiable control points can be used to supplement the ground control. These points include, but are not limited to; utility poles, corners of concrete structures, painted stripes, manhole covers, etc. Photo control points will not be referenced. RTK GPS survey procedures are permitted for this survey type.

c. Field Check Points. Random supplemental checkpoints at varying offsets from centerline will be obtained by the Consultant, resulting in approximately ten (10) points per mile of alignment. The points must be inside the mapping corridor limits. The accuracies shall be sufficient to support horizontal and vertical accuracy checks of the topographic mapping. The supplemental control points will not be referenced. RTK survey procedures are approved for this survey type.

VI. SPECIFICATIONS FOR SURVEY DELIVERABLES

The Consultant shall provide to the Commission the following items:

1) Three ASCII coordinate files all containing the primary control, photo control and check points for the project survey. These files are:

a. Ground Elevations. The photogrammetric control file. A file listing control positions by point number, X,Y, and Z values in project units. These values are referenced to the Missouri Coordinate System of 1983, zone name Zone, in an ASCII file format. The file will be named J######.ctl with specifications for file setup in Appendix A, Item 1.

b. Pin Elevations. The survey control file. A file listing control positions by point number, X, Y, and Z values in project units referenced to the Missouri Coordinate System of 1983, Zone name Zone, with X and Y values modified by the projection factor. This ASCII formatted file will be named J######.rec with specifications for file setup in Appendix A, Item 2.

c. The Geodetic Control File. A file containing latitude and longitude information for all control points named J######.txt with file format listed in appendix A, Item, 3. All OPUS solution sheets and/or data sheets from post processed static GPS sessions, calculations for grid and projection factor including the

centroid point, mean elevation and the final grid and projection factor will also be listed in this file.

2) **MoDOT Survey Report**. A MoDOT survey project report for each project. See Appendix A, Item 4.

3) Copies of all intervisible control survey pair station descriptions along with all benchmark descriptions and field ties. A sketch of each point shall be provided showing the relative location of field ties to the point being referenced.

4) The Consultant shall provide a letter certifying that the below mentioned surveying specifications have been achieved for this project. The letter shall document the relative positional accuracies in parts per million, the confidence level in percent, and the post adjustment residual values in centimeters that were achieved on this project. If any portion of the survey does not comply with these specifications, a written report substantiating the material variances from the specifications with the responsible surveyor's signature is required. The Commission reserves the right to disallow variations.

   The survey report documents proof of these specifications:

   a. Fixed preprocess baseline solutions.

   b. Control station relative positional accuracies of 10 ppm in relation to adjacent stations at the 95% confidence level.

   c. Post adjustment residual values < 3 cm in any dimension for control stations.

   d. A map of no greater than 1:24,000 scale (USGS Topography map) with all survey control points plotted and labeled on hardcopy, digital or both.

5) The Consultant shall provide a set of prints with the photo control and north arrow graphically depicted on the front of the print and a description of the point(s) printed on the back of the print.

6) The Consultant shall furnish the files on CD ROM format. All submittals shall consist of two CD ROMs, one shall be labeled "working set" and

one set labeled "archive set". In addition, the CD ROMs shall contain a text file describing the contents including project name, file names, Consultant's name and the date of submittal. This file shall be named contents.txt and be located in the root directory of the disk.

VII SPECIFICATIONS FOR VERTICAL AERIAL PHOTOGRAPHY

The following specifications set forth the minimum requirements that must be met by the Consultant when providing vertical aerial photography to the Missouri Department of Transportation (MoDOT).

1) All flights for mapping shall be flown at the elevation above mean terrain specified in Table II-1 with the following exception:

    a. Special situations may apply to projects that contain Narrow Valley Section Lines (NVSL) that fall outside the mapping corridor.

        i. If photo coverage for the NVSL cannot be obtained while flying the mapping corridor at specified photo scale, an additional flight line(s) can be used to obtain the NVSL at a photo scale of 1:6000.

    b. Reconnaissance photo scale (1:12000) for projects listed in Table II-1.

2) **Technical Specifications**. The Consultant shall provide the necessary aerial photographic coverage for the project. Specifications and instructions for delivery for aerial photography are contained in the Missouri Department of Transportation *Specifications for Vertical Aerial Photography*.

3) **Beginning the work**.

    a. No work shall be done without MoDOT notification that work may begin.

    b. There is no snow on the ground within the area to be photographed.

    c. The leaves are off deciduous trees.

d. The procedures indicated in the specifications will be followed.

e. The Consultant shall not fly until they receive notification that targets are in place.

4) **Last day for Photography Work.** All aerial photography shall be completed by **APRIL 1st, 2010** unless approved by MoDOT.

5) **Camera Calibration Reports.**

a. Digital camera, the Consultant shall provide the calibration report and/or the manufacture's recommended equivalent procedure. If a manufacturer recommended procedure is provided, a Statement of Compliance on company letterhead will be submitted. The statement of compliance will:

i. Certify that the manufacture's recommended procedure; was completed at the recommended intervals as required.

ii. Identify the date the procedure was last accomplished before the imagery was flown.

iii. Be signed by an authorized representative of the company submitting the Statement of Compliance.

b. If requested, the Consultant will submit a statement certifying that the camera has not been disturbed, repaired or modified in any fashion since the submitted calibration report or statement of compliance as made.

c. If at any time after award of the contract, the camera is disturbed, repaired or modified in any fashion, the Consultant shall submit to MoDOT a new calibration report or statement of compliance.

d. MoDOT reserves the right to restrict the use of any camera based upon the data contained in the calibration report, or based upon operational results.

6) Digital Camera Requirements.

a. Digital image data will be captured of selected sites using a high precision digital aerial mapping camera.

b. The digital framed camera system will have a focal length of 120 millimeters.

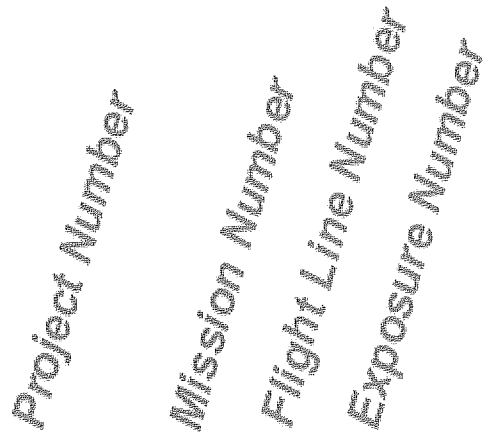
c. Black and White, color and color-infrared image data will be captured simultaneously.

d. The aircraft will be equipped with an Aerial Sensor Management System (ASMS) for guidance, positioning and flight management.

e. The camera will have digital forward motion compensation and gyro-mount leveling.

f. Airborne Global Positioning System (ABGPS) survey and Inertial Measurement Unit (IMU) measurement technology will be employed, estimating the imagery capture control stations. Consultant will use static logging information from base stations within MoDOT's GPS Reference Station Network for all post processing of ABGPS data. A user ID will be provided by MoDOT to access MoDOT's GPS Reference Station Network web site for the purpose of downloading the necessary GPS data accentual to post processing. GPS static data must be downloaded from GPS Reference Station Network web site within 30 days of flight.

g. The image filename must contain: the MoDOT project number, underscore mission number, underscore flight line number, underscore exposure number. See example:



Digital Image File Name: J8P0595C_897_10_100

7) **Post-Processing of Digital Imagery**. The Consultant shall be responsible for all post-processing of the digital aerial images to meet the following specifications.

   a. Imagery shall be delivered in RGB, CIR, and Panchromatic bands (three (3) separate files).

   b. Imagery shall be delivered as 8-bit depth Tagged Image File Format (TIFF) tile JPEG files. All digital files shall be compressed using a 3 to 1 compression ratio.

   c. Each photograph shall be manually annotated to include the MoDOT required information. The text shall be placed from left to right in the following order.

      i. The county of the image covered area. (The county is expressed by a number that will be provided by the Commission).

      ii. The numeric or alpha designation of the project route.

      iii. The photographic scale expressed as a ratio.

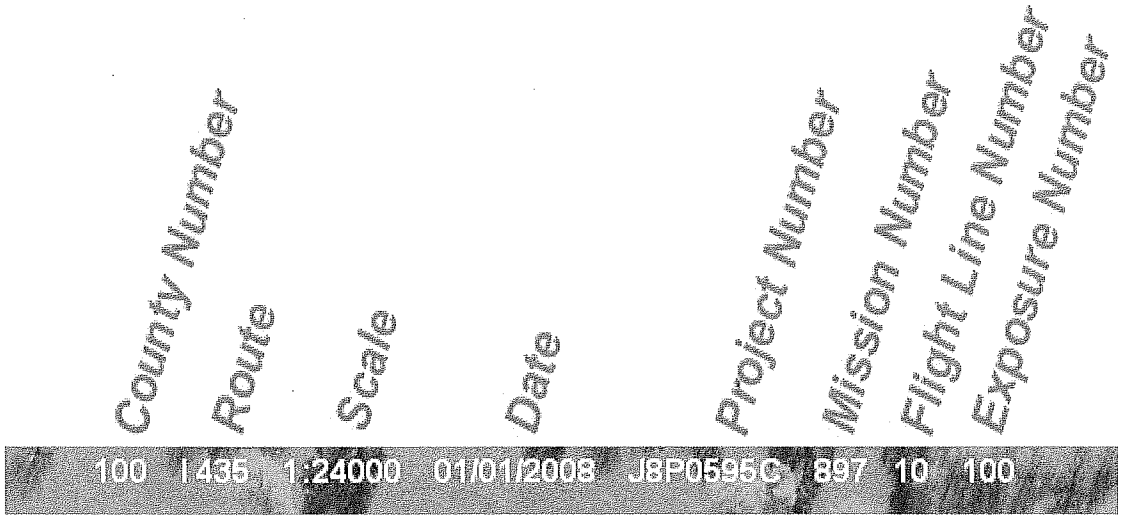
      iv. The date of the flight mission when the image was taken.

      v. Project number (i.e. J8P2202).

vi. Mission number. The commission will provide this number.

vii. The flight line number.

viii. The unique exposure number (exposures are numbered in sequence). The first exposure shall be labeled as exposure number one (1), with each succeeding exposure having a number one greater than the exposure before it.



8) Camera Location Data.

a. An electronic file is to be delivered for each project containing the photo centers of exposures.

b. The file name must contain the MoDOT project number.

c. Coordinate units must be in the datum/coordinate system of the project.

d. The file must be of CCNS4 or ASCOTT format.

e. The flight line and exposure numbers in the file must agree with the film stamping and flight map for film-based photography and with the image filename and flight map for digital photography.

9) Photographic Operations.

a. Flight Conditions. The photography shall be taken when the deciduous trees are bare and the ground is free of snow. It shall not be taken when the ground is obscured by haze, smoke or dust, or when clouds or shadows of clouds are present. Spring flying season photography shall be taken during the hours of mid-day (3 hours after sunrise to 3 hours before sunset).

b. Flight Lines. .All flight lines are intended to be along the center of the highway project, unless noted otherwise. Flight lines shall be continuous and straight with no breaks throughout the entire length of the flight line. Each project shall be flown in its entirety with the same camera. Flight lines shall not be flown around curves. All flights must consist of at least four photographs. The maximum angle of deviation between the actual flight path and the specified flight line shall not exceed three (3) degrees at any point on the line.

   Reflights for rejected exposures shall include the entire flight line unless the flight line contains more than fifteen (15) exposures in which case a portion of the flight line may, with written permission of MoDOT, be replaced. All reflights shall be centered on the plotted flight line(s) and shall be retaken with the same camera system as used in the original photography. For re-flights where only a portion of flight line is to be replaced, the reflight shall provide at least 100% overlap with accepted adjoining exposures in the same flight line. All reflights must be completed within the shortest practical time.

c. Flight Height. The departure above or below the required height above mean terrain to achieve the specified camera negative scale shall not exceed five (5) percent.

d. Exposure Overlap. The overlap shall be sufficient to provide full stereoscopic coverage as follows:

   i. End lap. The end lap (overlap in line of flight) shall average sixty (60) percent plus or minus two (2) percent. Endlap of less than fifty-five (55) percent or more then sixty-five (65) percent in one or more exposures may be

cause for rejection of the flight line or exposures in which such deficiency or excess of endlap occurs.

Whenever there is a change in direction of the flight lines, vertical photography on the beginning of a forward section shall endlap the photography of a back section by at least 300 percent (3 photographs).

ii. Side lap. Any flight line with an exposure having sidelap (overlap of parallel strips of vertical photography) of less than twenty (20) percent or more than forty (40) percent may be rejected. Side lap, per strip, shall average thirty (30) percent, plus or minus five (5) percent.

e. Crabbing, as measured from the line of flight indicated by the principal points of consecutive photographs, shall not change by more than five (5) degrees between any two consecutive photographs, and shall not average more than five (5) degrees on any one flight line, nor more than two (2) degrees for the entire mission.

f. Tilt, defined as the departure of the optical axis of the camera from a plumb line, shall not exceed five (5) degrees on a single photograph nor average more that one (1) degree for a single flight line. Relative tilt between two successive exposures shall not exceed six (6) degrees.

VIII SPECIFICATIONS FOR AERIAL PHOTOGRAPHY DELIVERABLES

The following materials shall be delivered to and shall become the property of MoDOT:

1) A copy of the flight map indicating the final exposure numbers that correspond with the contact prints and the direction of flight indicated by and arrow.

2) A copy of the camera calibration report or a statement of compliance.

3) Digital images from digital photography (all bands, RGB, CIR, and Panchromatic, delivered as three (3) separate files). Image files shall be delivered on a Fire Wire external hard drive, that will become the property of the Commission upon suspension.

4) CCNS-4 data containing the position of the photo and the name of the final as stamped photo. Naming convention will be the same for ASCOTT data.

CCNS File Name: J8P0802

Project #

5) For any LiDAR project, the following shall be delivered:

   a. Aerial imagery file in tiff format.

   b. GeoPak format Triangle Irregular Network (TIN) model.

   c. MicroStation design file (.dgn) showing 2-dimensional geometry using MoDOT CADD Standards.

   d. GeoPak coordinate database (.gpk).

IX ACCEPTANCE OF COMPLETED WORK

1) The Consultant shall submit all completed work promptly to allow time for proper review. Work reviewed and found in accordance with the specifications shall be considered to constitute "satisfactorily completed and accepted work".

2) The Missouri Department of Transportation will determine which photography work is in accordance with these specifications and represents acceptable work. Failure to produce acceptable work as specified, and after the Consultant has exercised the right to verify the quality of the work will cause the following:

   a. The Missouri Department of Transportation may reject that portion of the work and the Consultant will accept a hundred (100) percent reduction in payment, at the agreement price, for the affected portions of work.

   b. In the event that some work is found to be unacceptable in accordance with the specifications, and reworking is deemed necessary, the Consultant agrees that it shall re-fly such work

without expense to the Missouri Department of Transportation, even though final payment may have been received. The Consultant must give immediate attention to these changes so there will be a minimum delay. The above and foregoing is not to be construed as a limitation of the Missouri Department of Transportation right to seek recovery of damages for negligence on the part of the Consultant.

3) **Return of Source Data**. The Consultant shall return to the Commission all of the provided source data, including, all aerial photographs and maps.

4) **Data Quality**. The Consultant shall be responsible for the professional quality, technical accuracy and the coordination of data, documents and other services furnished for this project.

5) **Additional Services**. The Commission reserves the right to request additional work beyond the scope of services addressed in this document. In this event, a supplemental agreement shall be executed and approved prior to the performance of additional services. Changes in compensation will be addressed in the supplemental agreement.

6) **Documentation**. The Consultant shall provide any documentation necessary to explain, support and clarify the procedures used for data development. The Consultant shall be available to the Commission to discuss and interpret provided data.

7) **Data Ownership**. All data and documents prepared in performance of this Scope of Services shall be delivered to and become the property of the Commission upon suspension, abandonment, cancellation, termination, or completion of the Consultant's services.

X. SCHEDULE AND DELIVERY

I) **Aerial Photography** shall be taken as early as possible in the leaf-off flying season once the flight conditions are met. Projects that have targeted ground control points must be coordinated with the placing of targets and the photo mission so that a minimum of time will elapse between targeting and photography. MoDOT will identify priority sites needing final reports for mapping. All Photography shall be taken no later than **APRIL 1, 2010**. All aerial photography deliverables shall be received no later than end of business day on **APRIL 15, 2010**.

The Consultant shall continuously prosecute the work and survey deliverables shall be submitted to MoDOT as they are completed. The time of completion for all of the work addressed in these documents shall be **APRIL 15, 2010**.

2) **Extensions.** The Commission will grant time extensions for unavoidable delays beyond the control of the Consultant. Requests for extensions of time shall be in writing by the Consultant, before plans are due stating fully the reasons for the request.

3) **Materials to be delivered:**

   a. A set of prints with a north arrow and the photo control graphically depicted on the front of the print and a description of the point(s) and a reference to the corresponding field book printed on the back of the print.
   Example:
   Station #_____
   Book _____ Page _____
   Desc. of point _____
   Ground Elev. _____

   b. Survey reports and sketches.

4) All material shall be delivered to:

   Missouri Department of Transportation
   P.O. Box 270
   200 Harrison St.
   Jefferson City MO 65102
   Attention: Photogrammetry